

Appln. No. 10/070,012
Amdt. dated February 11, 2005
Reply to Office Action of August 12, 2004

PATENT

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

1. (Currently amended) A radio frequency (RF) down-convertor with reduced local oscillator leakage, for ~~demodulating an input signal $x(t)$~~ emulating the demodulation of an input signal $x(t)$ with a local oscillator signal having frequency f , said down-convertor comprising:

a synthesizer for generating mixing signals ϕ_1 and ϕ_2 which vary irregularly over time, where:

$\phi_1 * \phi_2$ has significant power at the frequency f of said local oscillator signal being emulated;

neither ϕ_1 nor ϕ_2 has significant power at the frequency f of said local oscillator signal being emulated; and

said mixing signals ϕ_1 and ϕ_2 are designed to emulate said local oscillator signal having frequency f , in a time domain analysis;

a first mixer coupled to said synthesizer for mixing said input signal $x(t)$ with said mixing signal ϕ_1 to generate an output signal $x(t) \phi_1$; and

a second mixer coupled to said synthesizer and to the output of said first mixer for mixing said signal $x(t) \phi_1$ with said mixing signal ϕ_2 to generate an output signal $x(t) \phi_1 \phi_2$, said output signal $x(t) \phi_1 \phi_2$ emulating the modulation of said input signal $x(t)$ with said local oscillator signal having frequency f .

2. (Currently amended) The radio frequency (RF) down-convertor of claim 1 wherein said synthesizer ~~further comprises:~~ is further operable to generate mixing signals ϕ_1 and ϕ_2 , such that the product $\phi_1 * \phi_1 * \phi_2$ will not result in a significant amount of power within the bandwidth of an input signal that the down-converter is designed to down-convert to baseband.

Appln. No. 10/070,012
Amdt. dated February 11, 2005
Reply to Office Action of August 12, 2004

PATENT

~~a synthesizer for generating mixing signals ϕ_1 and ϕ_2 , where $\phi_1 * \phi_1 * \phi_2$ does not have a significant amount of power within the bandwidth of said input signal $x(t)$ at baseband.~~

3. (Original) The radio frequency (RF) down-converter of claim 2, further comprising:

a DC offset correction circuit.

4. (Original) The radio frequency (RF) down-converter of claim 3, wherein said DC offset correction circuit comprises:

a DC source having a DC output; and

a summer for adding said DC output to an output of one of said mixers.

5. (Original) The radio frequency (RF) down-converter of claim 2, further comprising:

a closed loop error correction circuit.

6. (Previously presented) The radio frequency (RF) down-converter of claim 5, wherein said closed loop error correction circuit further comprises:

an error level measurement circuit and

a time varying signal modification circuit for modifying a parameter of one of said mixing signals ϕ_1 and ϕ_2 to minimize said error level.

7. (Original) The radio frequency (RF) down-converter of claim 6, wherein said error level measurement circuit comprises a power measurement.

8. (Original) The radio frequency (RF) down-converter of claim 6, wherein said error level measurement circuit comprises a voltage measurement.

9. (Original) The radio frequency (RF) down-converter of claim 6, wherein said error level measurement circuit comprises a current measurement.

Appl. No. 10/070,012
Amdt. dated February 11, 2005
Reply to Office Action of August 12, 2004

PATENT

10. (Previously presented) The radio frequency (RF) down-converter of claim 6, wherein said modified parameter is the phase delay of one of said mixing signals ϕ_1 and ϕ_2 .

11. (Previously presented) The radio frequency (RF) down-converter of claim 6, wherein said modified parameter is the fall or rise time of one of said mixing signals ϕ_1 and ϕ_2 .

12. (Previously presented) The radio frequency (RF) down-converter of claim 6, wherein said modified parameter includes both the phase delay and the fall or rise time of one of said mixing signals ϕ_1 and ϕ_2 .

13. (Previously presented) The radio frequency (RF) down-converter of claim 2 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals ϕ_1 and ϕ_2 , where said mixing signals ϕ_1 and ϕ_2 can change with time in order to reduce errors.

14. (Original) The radio frequency (RF) down-converter of claim 1, further comprising:

a filter for removing unwanted signal components from said $x(t)$ ϕ_1 signal.

15. (Currently amended) The radio frequency (RF) down-converter of claim 1, wherein said mixing signal ϕ_2 ~~are random~~ is a square wave.

16. (Currently amended) The radio frequency (RF) down-converter of claim 1, wherein said mixing signals ϕ_1 and ϕ_2 ~~are pseudo-random~~ effect the modulation of an in-phase component of said input signal $x(t)$, and a complementary down-converter with mixing signals 90 degrees out of phase, is used to effect the modulation of a quadrature component of said input signal $x(t)$.

Appl. No. 10/070,012
Amdt. dated February 11, 2005
Reply to Office Action of August 12, 2004

PATENT

17 (Previously presented) The radio frequency (RF) down-converter of claim 1, wherein said mixing signals ϕ_1 and ϕ_2 are irregular.

18. (Previously presented) The radio frequency (RF) down-converter of claim 1, wherein said mixing signals ϕ_1 and ϕ_2 are digital waveforms.

19. (Previously presented) The radio frequency (RF) down-converter of claim 1, wherein said mixing signals ϕ_1 and ϕ_2 are square waveforms.

20. (Original) The radio frequency (RF) down-converter of claim 1, further comprising:

a local oscillator coupled to said synthesizer for providing a signal having a frequency that is an integral multiple of the desired mixing frequency.

21. (Currently amended) A method of demodulating a radio frequency (RF) signal $x(t)$ with reduced local oscillator leakage comprising the steps of:

generating mixing signals ϕ_1 and ϕ_2 which vary irregularly over time, where:

ϕ_1 and ϕ_2 has significant power at the frequency f of a local oscillator signal being emulated, and neither ϕ_1 nor ϕ_2 has significant power at the frequency of said local oscillator signal being emulated; and

said mixing signals ϕ_1 and ϕ_2 are designed to emulate said local oscillator signal having frequency f , in a time domain analysis;

mixing said input signal $x(t)$ with said mixing signal ϕ_1 to generate an output signal $x(t) \phi_1$; and

mixing said signal $x(t) \phi_1$ with said mixing signal ϕ_2 to generate an output signal $x(t) \phi_1 \phi_2$.

22. (Previously presented) An integrated circuit comprising the radio frequency (RF) down-converter of claim 1.

23-24. Canceled.

Appl. No. 10/070,012

PATENT

Amdt. dated February 11, 2005

Reply to Office Action of August 12, 2004

25. (Previously presented) The radio frequency (RF) down-converter of claim 1, where said synthesizer uses different patterns to generate signals ϕ_1 and ϕ_2 .

26. (Previously presented) The radio frequency (RF) down-converter of claim 1, wherein said synthesizer uses a single time base to generate both mixing signals ϕ_1 and ϕ_2 .